# Eberline Services
# Rocky Flats Environmental Test Site
# Building 771 Stack
# LARADS Radiological Survey Report

## Addendum
## Additional Re-Investigation Points

Eberline Services
3200 George Washington Way
Richland, WA 99352
(509) 371-1506

Executive Summary

On Oct. 14, 2002, Eberline Services and TMR Associates returned to B771 Exhaust Stack and performed additional static counts at re-investigative locations that were greater than 2" from the original survey location.

This survey was performed using the same equipment used in the original survey - LARADS system with a 100 sq. cm alpha detector mounted on a mobile platform.

A total of 35 static measurements were taken. None of the results exceeded the specified action level.

Deliverables include this document, database files of the LARADS survey results, and CAD generated drawing showing color-coded radiological reading locations.

## I. Introduction

Eberline Services (ESI), in conjunction with teaming partner, TMR Associates, performed a re-investigative radiological survey of the interior surface of the B771 Exhaust Stack at the Rocky Flats Environmental Test Site (RFETS).

This survey was performed utilizing the Eberline Services Laser Assisted Ranging and Data System (LARADS) radiological mapping equipment mounted on TMR's Mobile Assisted Positioning System (MAPS).

Radiological instrumentation used consisted of Thermo Eberline's E600 count rate meter and their 380AB detector operated in scaler mode.

## II. Overview

The survey was conducted on Oct. 14 through 17, 2002.

MAPS and LARADS were deployed in a similar fashion as described for the original 2001 survey.

## III. Technical Approach – Statement of Work

Contractual Statement of Work from Kaiser-Hill read as follows:
*Eberline Services shall perform, analyze and report the results of a remotely controlled radiological re-survey of the interior surface of the B771 Exhaust Stack. Eberline Services will provide all instrumentation, equipment, and personnel required for performance of the re-survey, including a suitable air compressor for operation of the remote platform and assembly. K-H will provide escorted access to and around 771 and 110 VAC power at the monitoring location. K-H will provide a Radiological Control Technician and appropriate sources to perform detector operability confirmation twice a day. Voice radio and digital camera services will be supplied by the 771 Project as needed.*

***Scope and Measurement Specifications***

*Perform re-investigation of 28 locations as indicated on the List of Data Points to be Re-investigated below. These data points were previously identified by Eberline Services in their 2001 draft report as being more than 2 inches from the originally detected location, where elevated activity was identified > 75 dpm/100cm$^2$ using the average background for each detector or 100 dpm/100 cm$^2$ using the one-hour background information.*

- *Re-Detection must be within 1 inch horizontally and 2 inches vertically from original identified location of elevated activity*
- *Re-Detection must be located within 0.25inches of the surface to maintain the necessary geometry for alpha detection.*

- *Detection system shall be capable of achieving a minimum detectable activity (MDA) of less than 50 dpm/100 $cm^2$ for plutonium-239 alpha particles.*
- *Count times shall be adequate to attempt to achieve a minimum detectable activity (MDA) of less than 50 dpm/100 $cm^2$ for plutonium-239 alpha particles but shall be no greater than 300 seconds.*
- *All radiological measurements will utilize same make and model of instruments used by Eberline Services in the previous stack survey.*
- *Radiological instrumentation MUST be operability checked with the K-H supplied source within one hour of the start and finish of each data collection session.*
- *There shall be one background measurement for each elevation where measurements are taken. Static count time for background measurements will be the same as survey static measurements.*
- *For comparison purposes, a one-hour background shall be collected at the base of the stack interior with each detector used.*
- *The background number to be used for survey data reduction will be either the mean of the individual elevation backgrounds or the one-hour background taken at the base of the stack.*

*A minimum of six (6) follow-up investigations of locations that exceed 100 dpm/100$cm^2$ based upon this survey (or locations chosen by K-H) will be further investigated by taking eight (8) additional measurements within the one-square meter surrounding the location (one-square meter investigations).*

*I. Conditions and Costs*

*Eberline Services and their representatives will be granted access to the stack and surrounding area for the full workweek preceding the agreed upon field data collection date to mobilize equipment and other preparation activities.*

*Eberline Services is allocating four contiguous workdays for field data acquisition at the firm fixed price basis to K-H of $15,000.*

*If there are work delays beyond control of the Eberline Services that necessitate field data collection activities to exceed these four days, Eberline Services will extend this deployment at K-H request for up to an additional two (2) days at the cost to K-H of $3750 per day. Extended deployment beyond a total of six (6) workdays (original 4 days & additional 2 days) will require additional billing rate negotiations.*

*Airflow through the stack is a pre-determined condition; accordingly, instrument damage from this air will not be considered 'beyond the control' of the subcontractor.*

*Eberline Services and their representatives will be granted access to the stack and surrounding area for the full workweek after field data collection activities to demobilize equipment.*

***Deliverables***

- *One copy of raw data electronically on a Compact Disc*
- *One copy of analyzed data in hard copy and electronic format*
- *One copy of the text of the Radiological Survey report with Addendum, indexed and on a Compact Disc.*
- *One copy of the graphic presentation of the results on a Compact Disc*
- *Hardcopy of field logbook notes*

***List of Data Points to be Re-Investigated***

| XCOORD | YCOORD | ZCOORD |
|---|---|---|
| -4.95 | -4.94 | 18.06 |
| 0.77 | 5.41 | 28.07 |
| 0.91 | 5.71 | 32.06 |
| -0.01 | 5.95 | 35.01 |
| -0.16 | 6.38 | 39.98 |
| -0.17 | 6.37 | 41.04 |
| -6.56 | -0.17 | 46.07 |
| -6.53 | 0.00 | 49.03 |
| 5.00 | 3.02 | 50.35 |
| -6.49 | -0.02 | 52.93 |
| 6.14 | 0.42 | 56.41 |
| 5.90 | -0.42 | 57.06 |
| 6.18 | 0.00 | 68.04 |
| 0.81 | -5.21 | 102.98 |
| 0.22 | -5.37 | 103.98 |
| 0.08 | 4.81 | 109.98 |
| -5.13 | 0.12 | 110.98 |
| -0.18 | -5.20 | 112.06 |
| -5.06 | -0.12 | 120.00 |
| -4.81 | 0.00 | 150.04 |
| -0.15 | -3.64 | 150.06 |
| 3.74 | 0.24 | 150.07 |
| 0.20 | -3.51 | 150.99 |
| -4.81 | 0.18 | 153.01 |
| -4.22 | -0.42 | 167.95 |
| -0.20 | -4.38 | 168.02 |
| 0.07 | -4.36 | 168.92 |
| -4.13 | -0.42 | 168.93 |

The K-H Technical Representative, Sarah Roberts, amended this formal SOW in the field adding 7 additional data points to be re-investigated and modifying the following requirements:

- One-hour background for comparison purposes waived.

- Detector performance test (operational checks) can be performed once daily, in A.M., provided that in-tolerance performance tests bound measurements.

- No square meter average measurements required.

Minimum Detectable Concentration (MDC) was calculated using the guidance provided in NUREG-1507.

All measurements, both background and survey, were static measurements of 300-second duration.

**IV. Radiological Instrument Calibrations & Operation Checks**

The E600 and 380AB instrumentation were calibrated for Pu-239 alpha detection at the Pacific Northwest National Laboratory (PNNL) located at Richland, Washington. Copies of calibration information are included as Attachment A-I.

Relative alpha efficiency of 15% for Detector # 1697 and 13% for Detector # 1393 was reported by PNNL.

Operational checks were performed on each detector used both prior to and after each use. All operational check results were well within the $\pm$20% guideline established by ANSI and Eberline Services procedure. Attachment A-II contains the operation check information.

**V. Information on Survey Data Coordinate System**

The same coordinate system that was used for the original survey conducted in July 2001 was used for this re-investigation work. Please refer to the original report for further information on this coordinate system.

*Eberline Services*
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*Building 771 Stack*
*LARADS Radiological Survey Report*

**VI. Survey Data Discussion**

All field data was collected in Counts Per Minute (CPM) of alpha radiation. Two detectors, # 1393 and # 1697 were used to collect of survey data.

Electronic files of all the survey data discussed below are included as ESI deliverables for this survey project and are submitted with the Compact Disk that accompanies this report. Attachment A-III contains a list of these files as well as a description of the information contained within the database fields of these files.

## A. Radiological Background and MDA Determination

Background information, detector efficiency, and Minimum Detectable Activity (MDA) for each detector is listed in Table A-1.

**Table A-1**

| DETECTOR ID # | NUMBER OF 300-SECOND COUNTS TAKEN | AVG. BKG (300-SEC) CPM | DETECTOR EFFICENCY | MDA (300-SECOND COUNT TIMES) |
|---|---|---|---|---|
| 1393 | 20 | 3.66 | 13% | 35 dpm\100 $cm^2$ |
| 1697 | 15 | 8.89 | 15% | 45 dpm\100 $cm^2$ |

Backgrounds from the initial survey conducted in July-Aug of 2001 averaged 8.59 & 12.33 (90-second count times).

Lower backgrounds encountered here may be explained by considering two factors:

1. Weather conditions (In July-Aug 2001 B771 experienced several thunderstorms).
2. Decreased stack air flow (compared to the conditions during previous survey).

The lower backgrounds encountered in Oct. 2002, coupled with these two factors, support the hypothesis that the elevated backgrounds experienced during the initial survey were due to naturally occurring charged radon alpha particles collecting on the Mylar detector face.

Please see Section VI-A of initial survey report for more information.

## B. Radiological Survey Results

Conversion factors of 6.667 for Detector # 1697 and 7.69 for Detector # 1393 were used to report activity in Disintegrations Per Minute (DPM).

DPM conversion formula was applied as follows:

((Gross cpm) – (background cpm)) * (detector's conversion factor)

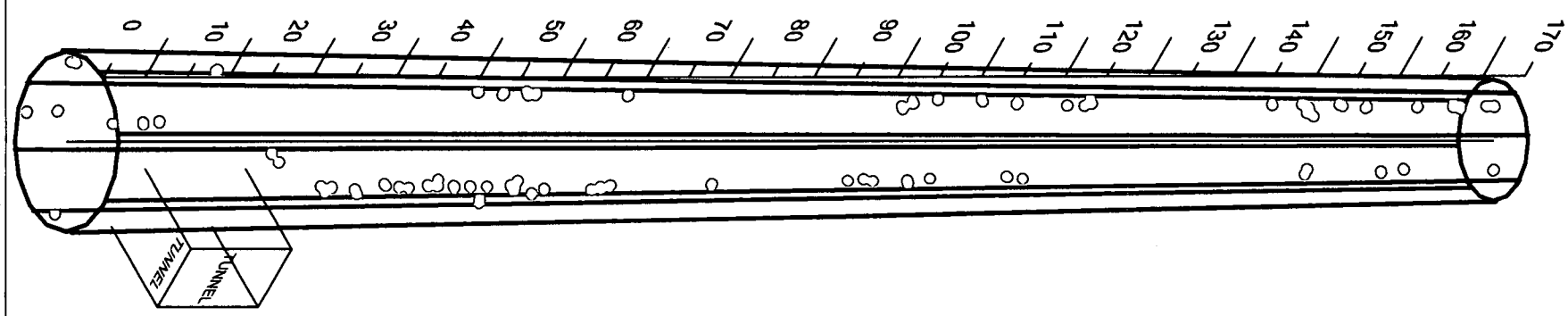
All cpm and dpm values listed in this report and within the electronic files are per $100cm^2$ unit area. The 380AB detector has $100cm^2$ of active area so no probe area calculations were necessary.

### 1. Survey Results

A total of 35 data points were collected in the survey of the stack area. None of these data points exceeded the action level of 100 dpm/100 $cm^2$.

All re-investigation data points were collected within 2" or less from the location of the initial survey data point collected in July-Aug 2001. Table A-2 lists original survey data point location, re-investigation data point (this survey) location, and the 3-dimensional distance delta.

Figures A1 through A4 contain color-coded data sets of the initial survey, initial re-investigation, and additional re-investigation data point locations.




Map Key

- ○ Original Elevated Reading Location
- ○ Re-Investigation (I & II) Location

# RFETS B771 Ventilation Stack
# LARADS Radiological Survey
# Initial & Reinvestigation Survey Locations
# Full View

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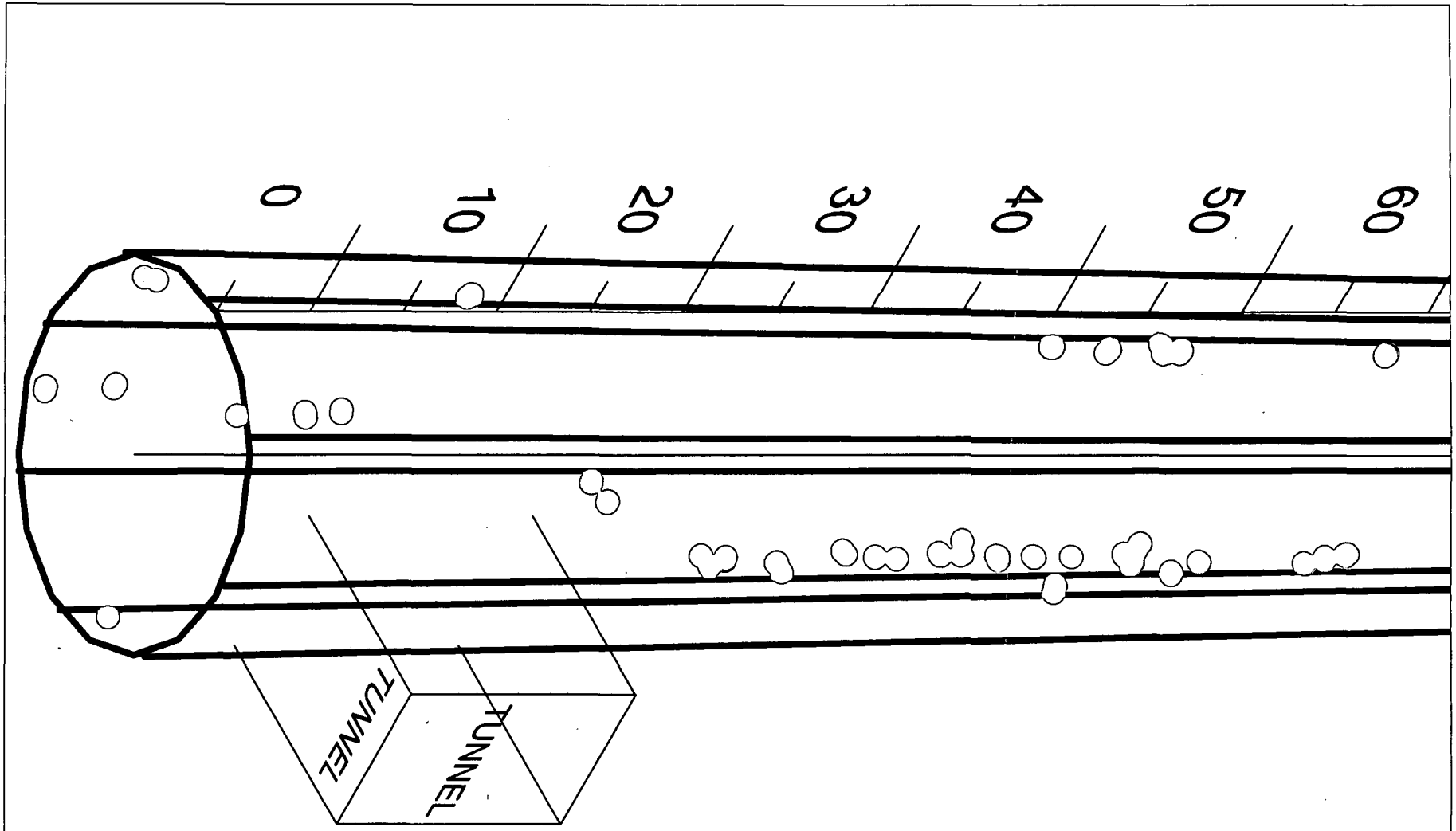
Figure A-1




Map Key

○ Original Elevated Reading Location
○ Re-Investigation (I & II) Location

RFETS B771 Ventilation Stack
LARADS Radiological Survey
Initial & Reinvestigation Survey Locations
Bottom Sec.

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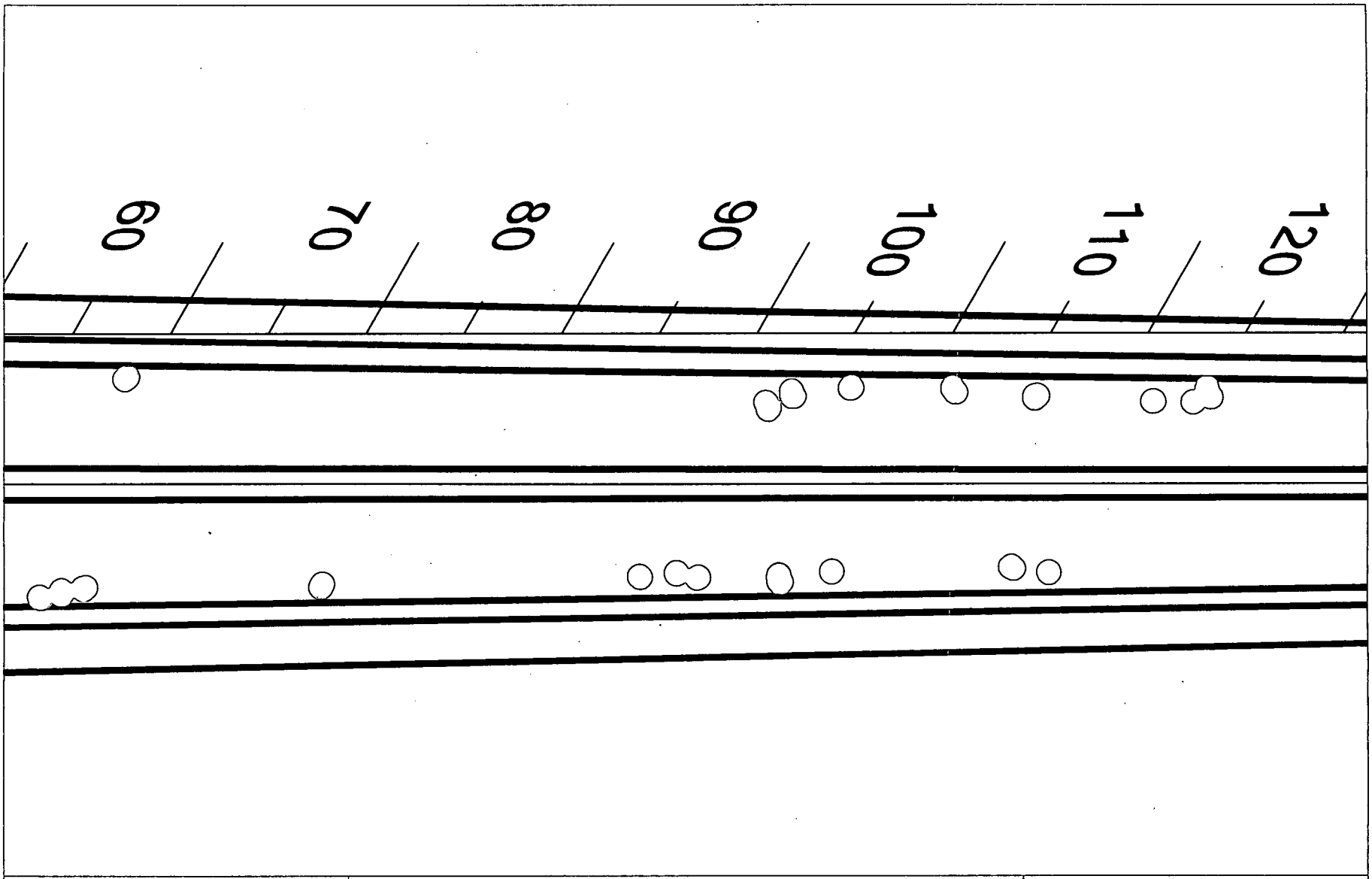
Figure A-2




Map Key

○ Original Elevated Reading Location
○ Re-Investigation (I & II) Location

# RFETS B771 Ventilation Stack
# LARADS Radiological Survey
# Initial & Reinvestigation Survey Locations
# Middle Sec.

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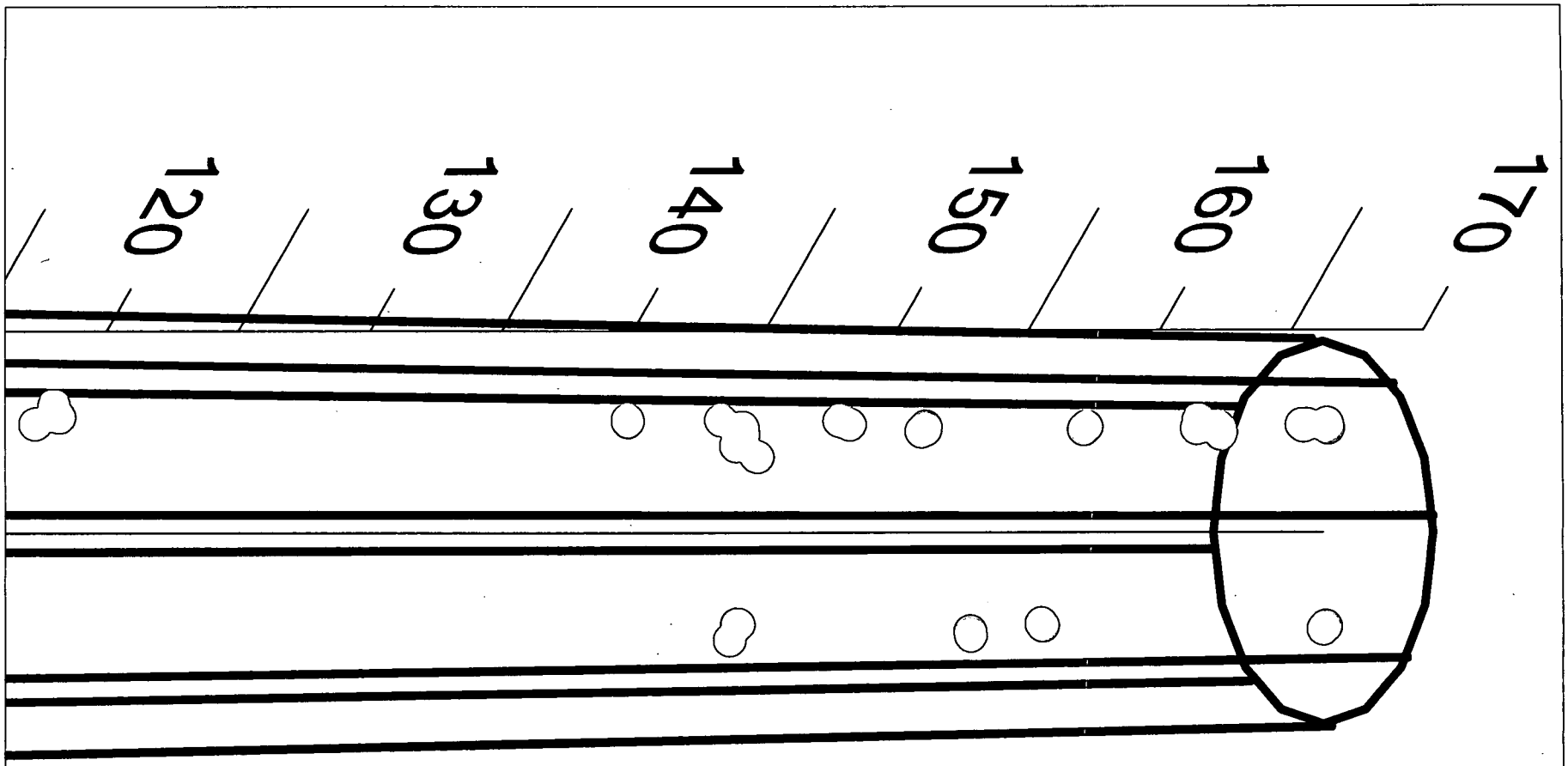
Figure A-3




Map Key

○ Original Elevated Reading Location
○ Re-Investigation (I & II) Location

RFETS B771 Ventilation Stack
LARADS Radiological Survey
Initial & Reinvestigation Survey Locations
Top Sec.

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Figure A-4

Table A-2
Survey Location Comparison

| | CONDUCTED JULY-AUG. 2001 | | | CONDUCTED OCT. 2002 | | | |
|---|---|---|---|---|---|---|---|
| ID # | ORIGINAL SURVEY XCOORD | ORGINAL SURVEY YCOORD | ORGINAL SURVEY ZCOORD | RE-INVESTIGATION XCOORD | RE-INVESTIGATION YCOORD | RE-INVESTIGATION ZCOORD | DELTA (INCHES) |
| 1 | 0.77 | 5.41 | 28.07 | 0.80 | 5.41 | 28.06 | 0.38 |
| 2 | 0.91 | 5.71 | 32.06 | 0.96 | 5.70 | 32.03 | 0.71 |
| 3 | -0.01 | 5.95 | 35.01 | -0.07 | 5.95 | 34.97 | 0.87 |
| 4 | -0.16 | 6.38 | 39.98 | -0.16 | 6.38 | 39.94 | 0.48 |
| 5 | -0.17 | 6.37 | 41.04 | -0.21 | 6.37 | 41.10 | 0.87 |
| 6 | -6.56 | -0.17 | 46.07 | -6.56 | -0.13 | 46.05 | 0.54 |
| 7 | -6.53 | 0.00 | 49.03 | -6.53 | -0.02 | 49.06 | 0.43 |
| 8 | 5.00 | 3.02 | 50.35 | 4.96 | 3.09 | 50.33 | 1.00 |
| 9 | -6.49 | -0.02 | 52.93 | -6.49 | 0.00 | 52.93 | 0.24 |
| 10 | 6.14 | 0.42 | 56.41 | 6.14 | 0.41 | 56.31 | 1.21 |
| 11 | 5.90 | -0.42 | 57.06 | 5.90 | -0.46 | 57.13 | 0.97 |
| 12 | 6.18 | 0.00 | 68.04 | 6.18 | -0.06 | 68.04 | 0.72 |
| 13 | 0.81 | -5.21 | 102.98 | 0.77 | -5.22 | 103.01 | 0.61 |
| 14 | 0.22 | -5.37 | 103.98 | 0.22 | -5.37 | 104.09 | 1.32 |
| 15 | 0.08 | 4.81 | 109.98 | 0.04 | 4.81 | 110.00 | 0.54 |
| 16 | -5.13 | 0.12 | 110.98 | -5.13 | -0.02 | 111.05 | 1.88 |
| 17 | -0.18 | -5.20 | 112.06 | -0.18 | -5.20 | 112.05 | 0.12 |
| 18 | -5.06 | -0.12 | 120.00 | -5.06 | -0.02 | 120.11 | 1.78 |
| 19 | -4.81 | 0.00 | 150.04 | -4.81 | 0.09 | 150.18 | 2.00 |
| 20 | -0.15 | -3.64 | 150.06 | -0.19 | -3.64 | 150.04 | 0.54 |
| 21 | 3.74 | 0.24 | 150.07 | 3.74 | 0.25 | 150.13 | 0.73 |
| 22 | 0.20 | -3.51 | 150.99 | 0.18 | -3.51 | 150.92 | 0.87 |
| 23 | -4.81 | 0.18 | 153.01 | -4.80 | 0.31 | 152.94 | 1.78 |
| 24 | -4.22 | -0.42 | 167.95 | -4.21 | -0.48 | 167.92 | 0.81 |
| 25 | -4.13 | -0.42 | 168.93 | -4.11 | -0.55 | 168.85 | 1.85 |
| 26 | -0.20 | -4.38 | 168.02 | -0.14 | -4.39 | 167.93 | 1.30 |
| 27 | 0.07 | -4.36 | 168.92 | 0.00 | -4.36 | 168.91 | 0.85 |
| 28 | -4.95 | -4.94 | 18.06 | -4.96 | -4.93 | 18.09 | 0.40 |
| 29 | 0.16 | 6.37 | 43.06 | 0.09 | 6.37 | 43.19 | 1.77 |
| 30 | -0.08 | 6.37 | 45.04 | -0.13 | 6.37 | 45.01 | 0.70 |
| 31 | -0.06 | 6.27 | 49.94 | -0.06 | 6.27 | 49.91 | 0.36 |
| 32 | -6.48 | 0.06 | 51.97 | -6.48 | 0.10 | 52.08 | 1.40 |
| 33 | 5.96 | 1.25 | 57.97 | 5.98 | 1.16 | 57.99 | 1.13 |
| 34 | 0.28 | 6.13 | 60.93 | 0.31 | 6.13 | 60.93 | 0.36 |
| 35 | 5.36 | 0.4 | 102.99 | 5.37 | 0.31 | 103.09 | 1.62 |

# Eberline Services

## Rocky Flats Environmental Test Site
## Building 771 Stack
## LARADS Radiological Survey Report

## Addendum
## Additional Re-Investigation Points

### Attachment A-I

### Instrument Calibration Reports

Eberline Services
3200 George Washington Way
Richland, WA 99352
(509) 371-1506

[redacted]

EBERLINE E-600 CALIBRATION DATA SHEET
RADIOLOGICAL CALIBRATION PROCEDURES, MANUAL MA-6

EBERLINE

Project # 98106:06 File Class: T6.5

Procedure: 3.9.5 Current Procedure Issued: 05/01 ICN: 08/01 Supersedes: 03/00 Page 1 of

Eberline Model E-600 SN 983

Barcode: CMEBD-1086

Barcode: DTL3-0007

Conventional Channel Calibrated With: Pancake GM ☐ Other ☑

If other is checked, Model 44-10 SN 154412

M&TE

Pulser Mfr/Model Eberline MP-2 Barcode: PGEBI-0004 Cal. Expires 11/02

DMM: Model Fluke 77 Barcode: MMFLI-0007 Cal. Expires 6-15-02

Pancake GM Detector S/N_____ Barcode: _____ Cal. Expires_____ N/A ☑

| Pulser C/m | As-Found c/m | | | As-Left c/m | | | Acceptable Range c/m |
|---|---|---|---|---|---|---|---|
| | Channel 1 | Channel 2 | Channel 3 | Channel 1 | Channel 2 | Channel 3 | |
| 200 X 1 | 200 | 200 | 200 | | | | 190 to 210 |
| 400 X 1 [1] | 400 | | | | | | 380 to 420 |
| 800 X 1 | 800 | | | | | | 760 to 840 |
| 200 X 10 | 1.99K | | | | | | 1.9 K to 2.1K |
| 800 X 10 | 7.98K | | | | | | 7.6K to 8.4K |
| 200 X 100 | 19.98K | | | | | | 19K to 21K |
| 800 X 100 | 79.8K | | | | | | 76K to 84K |
| 200 X 1K | 199.7K | | | | | | 190K to 210K |
| 800 X 1K | 799K | 799K | 799K | | | | 760K to 840K |
| SCALER CHECK (counts/1 minute) | | | | | | | |
| 800 X 100 | 79.8K | | | | | | 78400 to 81600 |
| | | | | Audio ☑ yes ☐ no | | Light ☑ yes ☐ no | |

No Adjustments

[1] Midpoint of most commonly used scale: ANSI N323-1978

NOTES: An "S" in the as-found column indicates no as-found readings available due to instrument repairs. All radiation standards used in this calibration are traceable to NIST. Calibration of M&TE is traceable to NIST. The acceptable tolerance for as-left readings is ±5% or ±20% if a correction factor chart is provided.

HIGH VOLTAGE CALIBRATION

| High Voltage Setting (E-600) | As-Found | | As-Left | | Acceptable Range (DMM) |
|---|---|---|---|---|---|
| 1246 ±5V | 1251 | V | 1251 | V | 1246 ± 10V |
| 2250 ±5V | 2256 | V | 2256 | V | 2250 ± 10V |

Comments: 7 700 KeV Gamma

[redacted] 3-26-02 3-26-03

Calibrated By Calibration Date Due for Recalibration

m Johnson

Reviewed and Approved By/Date

MAR 27 2002

COPY

Signatures indicate acceptability of calibration data as recorded above.

15

[redacted]

SODIUM IODIDE FOR USE WITH E-600 CALIBRATION PROCEDURE DATA SHEET
RADIOLOGICAL CALIBRATION PROCEDURES, MANUAL MA-505

EBERLINE

Project # 98106:06 File Class: T6.5

Procedure: 3.9.8 Issued: 05/01 Supersedes: 02/00 Page 1 of 1

E-600: S/N 983 N/A ☐

Model: 44-10 S/N 15412 Smart Pack ☐

Barcode: CMEBD-1086

Barcode: DTLL3-0007

M&TE

E-600: S/N _____ Barcode _____ Cal. Exp. Date _____ N/A ☑

Isotope 137Cs S/N 176050 Activity 1.66E6 d/m Cert. Date ~~3-20-02~~ 3/02 Exp. 98 3-16-02

Source to Detector Geometry Contact

| Channel # | Eff. From Prev. Cal. | As-Found | | | As-Left | | |
|---|---|---|---|---|---|---|---|
| | | Bkg, cpm | Gross, cpm | Eff. % | Bkg, cpm | Gross, cpm | Eff. % |
| 1 | 8.5% | 1643 | 142.7K | 8.5 | 1643 | 142.7K | 8.5 |
| PHA #1 2 | 3.3% | N/A | | | | | |
| PHA #2 3 | 2.9% | N/A | | | | | |

NOTES: An "S" in the as-found column indicates no as-found readings available due to instrument repairs. All radiation standards used in this calibration are traceable to NIST. Calibration of M&TE is traceable to NIST. The acceptable tolerance for as-left readings is ±10% or ±20% if a correction factor chart is provided.

Comments: 7300 Kd/ Gamma. PHA Calibration not needed per Marc Wendling.

[redacted] 3-26-02 3-26-03

Calibrated By Calibration Date Due for Recalibration

M Johnson

Reviewed and Approved By

Date MAR 27 2002

Signatures indicate acceptability of calibration data as recorded above.

EBERLINE E-600 CALIBRATION REPORT - V4.02

CNEBD-1086
DTL3-0007

EBERLINE

03/26/02 08:17:53

| | | |
|---|---|---|
| E-600 Serial Number | : | 983 |
| Program Version | : | E600 V4.01 |
| Calibration Date/Due Date | : | 03/26/02 to 03/26/03 |
| Scaler Precision | : | 10% |
| Lower Threshold Cal. Points | : | 1.80 mV and 6.00 mV |
| Upper Threshold Cal. Points | : | 6.00 mV and 60.0 mV |
| Lower Threshold Slope | : | 0.9048 |
| Lower Threshold Intercept | : | -0.0857 mV |
| Lower Threshold Span | : | 0.0947 mV (<=0.5) to 5.10 mV (>=5.0) |
| Upper Threshold Slope | : | 0.9741 |
| Upper Threshold Intercept | : | -0.6963 mV |
| Upper Threshold Span | : | 0.7148 mV (<=1.5) to 60.0 mV (>=50.0) |
| Alarm Editing | : | Enabled |
| Latching Alarms | : | Enabled |
| Auto Ranging | : | Enabled |
| Beep on Auto-Range | : | No |
| Ignore E-600 Cal. Date | : | No |
| Ignore Probe Cal. Date | : | No |
| Ratemeter Mode Support | : | Enabled |
| Integrate Mode Support | : | Enabled |
| Scaler Mode Support | : | Enabled |
| Peak Hold Mode Support | : | Enabled |
| Background Update Mode Support | : | Enabled |
| Log ID Source | : | Internal/Aux. |
| Star Key Ratemeter Function | : | Zero Display |
| Star Key Integrate Function | : | Zero Display |
| Scaler Display Units | : | Rate |
| Scaler Counting Mode | : | Fixed Time |
| | | |
| Conventional Probe Serial Number | : | 154412 |
| Type | : | 44-10 |
| Calibration Date/Due Date | : | 03/22/01 to 03/22/03 |
| Dead Time | : | 20.0 usec |
| Surface Area | : | 20.0 cm2 |
| Max High Voltage | : | 1600 Vdc |
| Overrange | : | 48000 cps |

[redacted]

CMEBD-1086
DTL3-0007

Probe 44-10 154412 continued...
Channel 1

| | |
|---|---|
| Channel Type | : Gamma |
| Rate Units | : cpm |
| Response Times | : 20,10,3 secs |
| High Voltage | : 488 Vdc |
| Lower Threshold | : 2.00 mV |
| Upper Threshold | : 60.0 mV |
| Selected Window | : Lower |
| Lower Cal. Constant | : 1.00 counts/count |
| Scaler Time | : 60 secs |
| Lower to Upper Crossover | : 0.0 |
| Upper to Lower Crossover | : 0.0 |

EBERLINE

Cable Length: 60 inches

Signature: [signature] Date: 3-26-02

[redacted]

EBERLINE SHP-380A(B) DATA SHEET
RADIOLOGICAL CALIBRATION PROCEDURES, MANUAL MA-563
Project # 98106:06 File Class: T6.5
Procedure: 3.9.6 Issued: 12/01 Supersedes: 06/00 Rev 5, Page 1 of 1

COPY

(Circle One)
SHP380AB or SHP380A SN 379

Barcode: OTEBY 1393

M&TE Eberline E-600 SN 747 Cal. Expires 10/02

| Isotope | SN | Activity | Cal. Exp. Date |
|---|---|---|---|
| Sry-90 | GH-793 | 102K dpm | 04/03 |
| Pu-239 | GH-790 | 54.7K dpm | 04/03 |
| Cs-137 | GH-788 | 99.8K dpm | 04/03 |

AS-FOUND

| Isotope | Background (Channel) | | Gross, cpm | Efficiency | HV |
|---|---|---|---|---|---|
| $^{90}Sr(Y)$ | — | β | NA | | |
| $^{239}Pu$ | 0 | α | 7.02K | 13% | 703 |

RADIOLOGICAL CALIBRATION Source/Detector Distance ¼ inch HV 703

| Isotope | Activity (dpm) | Gross count rate (cpm) α Ch. | Gross count rate (cpm) β Ch. | Efficiency 100*(cpm/dpm) | | Acceptance Criteria | |
|---|---|---|---|---|---|---|---|
| Background | | 1 | NA | | | 150 to 350 cpm β, ≤3 cpm α | |
| | | | | | | Rugged Window* | Regular Window |
| $^{90}Sr(Y)$ | 102K | NA | NA | — | β | ≥15% β | ≥20% β, ≤0.2% α |
| $^{137}Cs$ | 99.8K | NA | NA | — | β | ≥10% β | ≥15% β |
| $^{239}Pu$ | 54.7K | 7.04K | NA | 13% | α | ≥10% α | ≥10% α |
| | | | | | α or β | | |

Disabled Channels: 1 ☐ 2 ☑ 3 ☑ None ☐

NOTES: An "S" in the as-found column indicates no as-found readings available due to instrument repairs. All radiation standards used in this calibration are traceable to NIST. Calibration of M&TE is traceable to NIST. The acceptable tolerance for as-left readings is ±10% or ±20% if a correction factor chart is provided.

Comments: Alpha only

*Minimum efficiency for beta-only probes with rugged windows have tyvek, extra screen or other material to protect window. Alpha cross-talk is not a concern for these type detectors since they are calibrated for beta only and only use one channel.

A. Utter
Calibrated By

9/26/02
Calibration Date

9/26/03
Due for Recalibration

Reviewed and Approved By Date

Signatures indicate acceptability of calibration data as recorded above.

[redacted]

19

DTEBY-1393

COPY

EBERLINE E-600 CALIBRATION REPORT - V4.02

09/26/02 07:46:21 Probe Only

| | |
|---|---|
| E-600 Serial Number | : 747 |
| Smart Probe Serial Number | : 379 |
| Type | : SHP380A |
| Calibration Date/Due Date | : 09/26/02 to 09/26/03 |
| Dead Time | : 8.00 usec |
| Surface Area | : 100 cm2 |
| Max High Voltage | : 1000 Vdc |
| Overrange | : 80000 cps |
| Channel 1 | |
| Channel Type | : Alpha |
| Rate Units | : cpm |
| Response Times | : 20,20,20 secs |
| High Voltage | : 703 Vdc |
| Lower Threshold | : 2.00 mV |
| Upper Threshold | : 10.1 mV |
| Selected Window | : Upper |
| Upper Cal. Constant | : 1.00 counts/count |
| Scaler Time | : 300 secs |
| Lower to Upper Crossover | : 0.0 |
| Upper to Lower Crossover | : 0.0 |

Cable Length: 30 inches

Signature: [signature] Date: 9/26/02

[redacted]

20

EBERLINE SHP-380A(B) DATA SHEET
RADIOLOGICAL CALIBRATION PROCEDURES, MANUAL MA-563
Project # 98106:06 File Class: T6.5
Procedure: 3.9.6 Issued: 12/01 Supersedes: 06/00 Rev 5, Page 1 of 1



(Circle One)
SHP380AB or SHP380A SN 813

Barcode: OTEBY-1697

M&TE Eberline E-600 SN 747 Cal. Expires 10/02

| Isotope | SN | Activity | Cal. Exp. Date |
|---|---|---|---|
| Sry-90 | GH-793 | 102K dpm | 04/03 |
| Pu-239 | GH-790 | 54.7K dpm | 04/03 |
| Cs-137 | GH-788 | 99.8K dpm | 04/03 |

**AS-FOUND**

| Isotope | Background (Channel) | | Gross, cpm | Efficiency | HV |
|---|---|---|---|---|---|
| $^{90}Sr(Y)$ | | β | NA | | |
| $^{239}Pu$ | 2 | α | 8.13K | 15% | 557 |

**RADIOLOGICAL CALIBRATION** Source/Detector Distance ¼ inch HV 547

| Isotope | Activity (dpm) | Gross count rate (cpm) α Ch. | Gross count rate (cpm) β Ch. | Efficiency 100*(cpm/dpm) | | Acceptance Criteria | |
|---|---|---|---|---|---|---|---|
| Background | | 2 | NA | | | 150 to 350 cpm β, ≤3 cpm α | |
| | | | | | | Rugged Window* | Regular Window |
| $^{90}Sr(Y)$ | 102K | NA | NA | — | β | ≥15% β | ≥20% β, ≤0.2% α |
| $^{137}Cs$ | 99.8K | NA | NA | — | β | ≥10% β | ≥15% β |
| $^{239}Pu$ | 54.7K | 8.15K | NA | 15% | α | ≥10% α | ≥10% α |
| | | | | | α or β | | |

Disabled Channels: 1 ☐ 2 ☒ 3 ☒ None ☐

NOTES: An "S" in the as-found column indicates no as-found readings available due to instrument repairs. All radiation standards used in this calibration are traceable to NIST. Calibration of M&TE is traceable to NIST. The acceptable tolerance for as-left readings is ±10% or ±20% if a correction factor chart is provided.

Comments: Alpha only

*Minimum efficiency for beta-only probes with rugged windows have tyvek, extra screen or other material to protect window. Alpha cross-talk is not a concern for these type detectors since they are calibrated for beta only and only use one channel.

A. Utter — Calibrated By
9/26/02 — Calibration Date
9/26/03 — Due for Recalibration

Reviewed and Approved By Date

Signatures indicate acceptability of calibration data as recorded above.

[redacted]

EBERLINE E-600 CALIBRATION REPORT - V4.02

DTEB-Y-1697 COPY

09/26/02 08:02:39 Probe Only

| | |
|---|---|
| E-600 Serial Number | : 747 |
| Smart Probe Serial Number | : 813 |
| Type | : SHP380A |
| Calibration Date/Due Date | : 09/26/02 to 09/26/03 |
| Dead Time | : 8.00 usec |
| Surface Area | : 100 cm2 |
| Max High Voltage | : 1000 Vdc |
| Overrange | : 80000 cps |
| Channel 1 | |
| Channel Type | : Alpha |
| Rate Units | : cpm |
| Response Times | : 20,20,20 secs |
| High Voltage | : 547 Vdc |
| Lower Threshold | : 2.00 mV |
| Upper Threshold | : 10.1 mV |
| Selected Window | : Upper |
| Upper Cal. Constant | : 1.00 counts/count |
| Scaler Time | : 300 secs |
| Lower to Upper Crossover | : 0.0 |
| Upper to Lower Crossover | : 0.0 |

Cable Length: 30 inches

Signature: [signature] Date: 9/26/02

[redacted]

# Eberline Services

## Rocky Flats Environmental Test Site
## Building 771 Stack
## LARADS Radiological Survey Report

## Addendum
## Additional Re-Investigation Points

### Attachment A-II

### Instrument Performance Checks

Eberline Services
3200 George Washington Way
Richland, WA 99352
(509) 371-1506

# Environmental Survey Instrument Data Sheet



| Project: 771 Stack Re-Survey | Dates Covered From:10-14-02 To:10-18-02 | ESID Number: NA |
|---|---|---|

**Instrument/Probe Information**

| Instrument Serial Number:1086 | Instrument Type: E-600 | Calibration Date: 3/26/02 | Calibration Due Date: 3/26/03 | | |
|---|---|---|---|---|---|
| Probe Serial Number: 1393 | Probe Type/Model: SHP380A | Calibration Date:9/26/02 | Calibration Due Date: 9/26/03 | Alpha Eff: 13% | Beta/Gamma Eff: NA |

**Alpha Source Information**

| Source Number: TS 3985 | Source Isotope: Pu239 | Source Activity: 28,800 DPM | Assay Date: 8/5/02 |
|---|---|---|---|

**Beta/Gamma Source Information**

| Source Number:NA | Source Isotope:NA | Source Activity:NA | Assay Date:NA |
|---|---|---|---|

**Instrument Response Check**

| Date:10/14/02 | Time:0900 | Technologist Name/Signature: *<original signed by Paul Brenberger>* | |
|---|---|---|---|
| Alpha Background ( 0 ): | Alpha Count Time (min.): 1Min | Beta/Gamma Background ( ): NA | Beta/Gamma Count Time (min): NA |

| Count Number | Alpha Source Count Rate ( ) | Beta Sources Count Rate ( ) |
|---|---|---|
| 1 | 6160 | NA |
| 2 | 6110 | NA |
| 3 | 6180 | NA |
| 4 | 6110 | NA |
| 5 | 6070 | NA |
| 6 | 6120 | NA |
| 7 | 6140 | NA |
| 8 | 6080 | NA |
| 9 | 6180 | NA |
| 10 | 6120 | NA |

| Mean Alpha Net Source Measurement ( 6127) | Alpha Upper Bound (average + 20%) 7352 | Alpha Lower Bound (average - 20%) 4901 |
|---|---|---|
| Mean Beta Source Net Measurement ( NA ) | Beta/Gamma Upper Bound (average + 20%) NA | Beta/Gamma Lower Bound (average - 20%) NA |

| Reviewed By (print and sign) *<Original Signed by Marc Wendling>* | Date |
|---|---|

# Radiological Record
## Environmental Survey Instrument Data Sheet

Page ____ of ____

| Project:771-Stack Resurvey | Dates Covered From:10/14/02 To:10/18/02 | ESID Number:NA | Probe Serial Number:1393 |
|---|---|---|---|

## Operational Checks

| | | | Alpha | | | Beta/Gamma | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Date | Time | Background ( ) | Source Check ( ) | P/F* | Background ( ) | Source Check ( ) | P/F* | TECH Initials |
| Pre | 10/14/02 | 0910 | 0 | 6120 | P | NA | NA | NA | PB |
| Post | 10/16/02 | 0730 | 0 | 6280 | P | NA | NA | NA | PB |
| Pre | 10/16/02 | 0730 | 0 | 6280 | P | NA | NA | NA | PB |
| Post | 10/17/02 | 0725 | 0 | 6240 | P | NA | NA | NA | PB |
| Pre | 1017/02 | 0725 | 0 | 6240 | P | NA | NA | NA | PB |
| Post | 10/18/02 | 0930 | 0 | 6230 | P | NA | NA | NA | PB |
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| Reviewed By (print and sign) <*Original Signed by Marc Wendling*> | Date |
|---|---|

# Environmental Survey Instrument Data Sheet



| Project: 771 Stack Re-Survey | Dates Covered From:10-14-02 To:10-18-02 | ESID Number: NA |
|---|---|---|

**Instrument/Probe Information**

| Instrument Serial Number:1086 | Instrument Type: E-600 | Calibration Date: 3/26/02 | Calibration Due Date: 3/26/03 | | |
|---|---|---|---|---|---|
| Probe Serial Number: 1697 | Probe Type/Model: SHP380A | Calibration Date:9/26/02 | Calibration Due Date: 9/26/03 | Alpha Eff: 15% | Beta/Gamma Eff: NA |

**Alpha Source Information**

| Source Number: TS 3985 | Source Isotope: Pu239 | Source Activity: 28,800 DPM | Assay Date: 8/5/02 |
|---|---|---|---|

**Beta/Gamma Source Information**

| Source Number:NA | Source Isotope:NA | Source Activity:NA | Assay Date:NA |
|---|---|---|---|

**Instrument Response Check**

| Date:10/14/02 | Time:0900 | Technologist Name/Signature: *<Original Signed by Paul Brenberger>* | |
|---|---|---|---|
| Alpha Background ( 0 ): | Alpha Count Time (min.): 1Min | Beta/Gamma Background ( ): NA | Beta/Gamma Count Time (min): NA |

| Count Number | Alpha Source Count Rate ( ) | Beta Sources Count Rate ( ) |
|---|---|---|
| 1 | 7090 | NA |
| 2 | 7060 | NA |
| 3 | 7020 | NA |
| 4 | 6970 | NA |
| 5 | 6940 | NA |
| 6 | 6920 | NA |
| 7 | 7020 | NA |
| 8 | 7000 | NA |
| 9 | 7070 | NA |
| 10 | 6920 | NA |

| Mean Alpha Net Source Measurement ( 7001) | Alpha Upper Bound (average + 20%) 8401 | Alpha Lower Bound (average - 20%) 5601 |
|---|---|---|
| Mean Beta Source Net Measurement ( NA ) | Beta/Gamma Upper Bound (average + 20%) NA | Beta/Gamma Lower Bound (average - 20%) NA |

| Reviewed By (print and sign) *<Original Signed by Marc Wendling>* | Date |
|---|---|

# Radiological Record
# Environmental Survey Instrument Data Sheet

Page ____ of ____

| Project:771-Stack Resurvey | Dates Covered From:10/14/02 To:10/18/02 | ESID Number:NA | Probe Serial Number:1697 |
|---|---|---|---|

## Operational Checks

| | | | Alpha | | | Beta/Gamma | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Date | Time | Background ( ) | Source Check ( ) | P/F* | Background ( ) | Source Check ( ) | P/F* | TECH Initials |
| Pre | 10/14/02 | 0925 | 0 | 6830 | P | NA | NA | NA | PB |
| Post | 10/15/02 | 0730 | 0 | 7000 | P | NA | NA | NA | PB |
| Pre | 10/15/02 | 0730 | 0 | 7000 | P | NA | NA | NA | PB |
| Post | 10/16/02 | 0730 | 0 | 6970 | P | NA | NA | NA | PB |
| Pre | 10/16/02 | 0730 | 0 | 6970 | P | NA | NA | NA | PB |
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| Reviewed By (print and sign) *<Original Signed by Marc Wendling>* | Date |
|---|---|

# Eberline Services

## Rocky Flats Environmental Test Site
## Building 771 Stack
## LARADS Radiological Survey Report

## Addendum
## Additional Re-Investigation Points

### Attachment A-III

### Electronic Deliverable Information

Eberline Services
3200 George Washington Way
Richland, WA 99352
(509) 371-1506

Electronic deliverables include the following:

Narrative

ESI-B771 STACK REPORT - ADDENDUM.DOC - This report in Microsoft Word format.

ESI-B77 STACK REPORT - ADDENDUM.PDF - This report in Abode pdf format.

Figures – Figures from this report in Adobe pdf format.

FIG A1.PDF
FIG A2.PDF
FIG A3.PDF
FIG A4.PDF

Drawings – All in AutoDesk's AutoCad 2000 format

ESI_B771S_OCT02.DWG – Base for Figures 1 through 4

Data Files – All in Microsoft Excel format.

BK1393.XLS – Background results for detector # 1393.
BK1697.XLS – Background results for detector # 1697
B771S_LARADS ADDITIONAL REINVESTIGATION DATA.XLS – Survey results.

Information contained in database fields:

B771S_ – Consecutive identifier of data points.

ORG_XCOORD - X-axis positional coordinate in feet from origin at center of stack bottom of the original survey data point location.

ORG_YCOORD - Y-axis positional coordinate in feet from origin at center of stack bottom of the original survey data point location.

ORG_ZCOORD - Z-axis positional coordinate in feet (elevation) from center of stack bottom of the original survey data point location.

XCOORD – X-axis positional coordinate in feet from origin at center of stack bottom for this re-investigation data point.

YCOORD – Y-axis positional coordinate in feet from center of stack bottom for this re-investigation data point.

ZCOORD – Z-axis positional coordinate in feet (elevation) from center of stack bottom for this re-investigation data point.

DELTA_INCHES – Distance of re-investigation data point from the original survey data point (inches).

DATETIME – Date and time reading obtained.

E600 – CRM meter identification. For example, calibration facility uses CMEBD-1086; this is truncated to 1086 in this field.

DETECT_ID – Specific detector identifier using truncation as discussed for E600 field.

TYPE1 – Type of measurement being conducted, in this case all Alpha.

UNITS1 – Units of measure for the CPM1 field result, in this case all CPM.

CPM1 – Gross counts per minute for this data point radiological reading.

BKG_CPM – Mean of 300-second background reading results for specific detector used.

NETCPM – (CPM1 field – BKG_CPM field) Net CPM for this specific detector and measurement using the mean 300-second backgrounds result.

DPM – Calculated WGP activity per 100 cm sq. result for this specific reading.